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Appendix 1.1: Top 5 country visual snapshot





















Below is a visual snapshot showing the top 5 countries ranked by their (%) proportion of high-impact research output across 44 technologies. We have added a column (far right), which we've called 'Technology monopoly risk'. This metric seeks to highlight *concentrations of technological expertise in a single country*. It includes:

- number 1 country's share of world's top 10 institutions
- number 1 country's lead over closest competitor (ratio of respective share of top 10% publications)
- a traffic-light rating:
 - high = **8+/10** top institutions in no. 1 country *and* at least **3x times research lead**
 - medium = **5+/10** top institutions in no. 1 country *and* at least **2x times research lead**
 - low = medium criteria not met









































Advanced materials and manufacturing

Technology	Top 5 countries					Technology monopoly risk
Nanoscale materials and manufacturing	 58.35%	 6.73%	 4.90%	 4.06%	 3.84%	10/10 8.67 high
Coatings	 58.47%	 7.34%	 5.97%	 3.22%	 2.84%	8/10 7.96 high
Smart materials	 42.57%	 8.13%	 6.96%	 6.69%	 3.27%	7/10 5.24 medium
Advanced composite materials	 40.82%	 14.03%	 7.30%	 4.04%	 3.93%	8/10 2.91 medium
Novel metamaterials	 45.56%	 16.90%	 4.01%	 3.89%	 3.01%	7/10 2.70 medium
High-specification machining processes	 36.21%	 13.84%	 11.75%	 3.59%	 2.85%	8/10 2.62 medium
Advanced explosives and energetic materials	 47.10%	 21.31%	 4.88%	 3.96%	 3.23%	5/10 2.21 medium
Critical minerals extraction and processing	 36.68%	 13.39%	 4.47%	 2.79%	 2.68%	4/10 2.74 low











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Advanced magnets and superconductors	 33.36%	 16.37%	 7.54%	 7.09%	 5.01%	4/10 2.04 low
Advanced protection	 35.05%	 18.72%	 5.26%	 4.74%	 3.04%	6/10 1.87 low
Continuous flow chemical synthesis	 24.64%	 13.90%	 5.73%	 5.10%	 3.85%	4/10 1.77 low
Additive manufacturing (incl. 3D printing)	 20.41%	 20.25%	 6.38%	 5.27%	 4.34%	5/10 1.01 low








































Artificial intelligence, computing and communications

Technology	Top 5 countries					Technology monopoly risk
Advanced radiofrequency communications (incl. 5G and 6G)	 29.65%	 9.50%	 5.18%	 4.89%	 4.83%	8/10 3.12 high
Advanced optical communications	 37.69%	 12.76%	 5.64%	 3.88%	 3.48%	8/10 2.95 medium
Artificial intelligence (AI) algorithms and hardware accelerators	 36.62%	 13.26%	 4.20%	 4.15%	 3.48%	7/10 2.76 medium
Distributed ledgers	 28.38%	 11.32%	 8.94%	 5.54%	 4.81%	6/10 2.51 medium
Advanced data analytics	 31.23%	 15.45%	 6.02%	 4.19%	 3.92%	8/10 2.02 medium
Machine learning (incl. neural networks and deep learning)	 33.20%	 17.93%	 4.87%	 3.87%	 3.32%	7/10 1.85 low
Protective cybersecurity technologies	 23.33%	 16.80%	 7.67%	 5.71%	 5.20%	5/10 1.33 low
High performance computing	 29.31%	 25.57%	 6.34%	 4.68%	 3.98%	3/10 1.15 low

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Advanced integrated circuit design and fabrication	 24.18%	 21.19%	 7.16%	 4.46%	 3.57%	4/10 1.14 low
Natural language processing (incl. speech and text recognition and analysis)	 25.73%	 23.57%	 5.74%	 4.55%	 3.37%	5/10 1.09 low

Energy and environment
















Technology	Top 5 countries					Technology monopoly risk
Hydrogen and ammonia for power	 60.43%	 6.74%	 4.71%	 2.83%	 2.80%	9/10 8.97 high
Supercapacitors	 64.19%	 7.28%	 4.89%	 4.78%	 2.03	10/10 8.81 high
Electric batteries	 65.44%	 11.87%	 3.81%	 2.80%	 2.43%	10/10 5.51 high
Photovoltaics	 39.33%	 9.18%	 5.40%	 4.90%	 3.30%	7/10 4.28 medium
Nuclear waste management and recycling	 35.95%	 16.55%	 6.51%	 4.51%	 4.39%	8/10 2.17 medium
Directed energy technologies	 39.09%	 19.08%	 5.88%	 5.34%	 2.85%	7/10 2.05 medium
Biofuels	 23.15%	 15.48%	 5.48%	 4.42%	 3.65%	5/10 1.50 low
Nuclear energy	 26.83%	 20.45%	 6.11%	 4.39%	 4.26%	4/10 1.31 low

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Quantum

Technology	Top 5 countries					Technology monopoly risk
Quantum computing	 33.90%	 15.03%	 6.11%	 5.52%	 4.13%	8/10 2.26 medium
Post-quantum cryptography	 30.98%	 13.30%	 6.41%	 4.73%	 3.69%	4/10 2.30 low
Quantum communications (incl. quantum key distribution)	 31.47%	 16.68%	 7.58%	 6.45%	 3.81%	5/10 1.89 low
Quantum sensors	 23.70%	 23.27%	 7.76%	 4.29%	 4.20%	2/10 1.02 low

Biotechnology, gene technology and vaccines




Technology	Top 5 countries					Technology monopoly risk
Synthetic biology	 52.42%	 16.75%	 3.32%	 3.07%	 2.91%	9/10 3.13 high
Biological manufacturing	 26.01%	 10.35%	 9.08%	 3.85%	 3.17%	6/10 2.51 medium
Vaccines and medical countermeasures	 28.31%	 12.57%	 6.18%	 6.06%	 5.14%	8/10 2.25 medium

Sensing, timing and navigation

Technology	Top 5 countries					Technology monopoly risk
Photonic sensors	 42.72%	 12.52%	 5.74%	 3.61%	 3.06%	8/10 3.41 high

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Defence, space, robotics and transportation

Technology	Top 5 countries					Technology monopoly risk
Advanced aircraft engines (incl. hypersonics)	 48.49%	 11.69%	 6.96%	 3.93%	 3.60%	7/10 4.15 medium
Drones, swarming and collaborative robots	 36.07%	 10.30%	 6.13%	 5.15%	 4.53%	5/10 3.50 medium
Small satellites	 24.49%	 17.32%	 7.82%	 4.36%	 4.11%	5/10 1.41 low
Autonomous systems operation technology	 26.20%	 21.01%	 5.28%	 5.11%	 3.55%	3/10 1.25 low
Advanced robotics	 27.89%	 24.64%	 5.49%	 4.81%	 3.79%	4/10 1.13 low
Space launch systems	 19.67%	 18.24%	 9.81%	 8.18%	 6.53%	1/10 1.08 low